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Comparison Analysis of the Eastern Range TICO, False Cape and Mosquito Lagoon 915-MHz DRWP

Maggire D. Fielder, Linc
Robert E. Barbre, Jr., Jacobs
Jacobs Space Exploration Group
MSFC Natural Environments Branch
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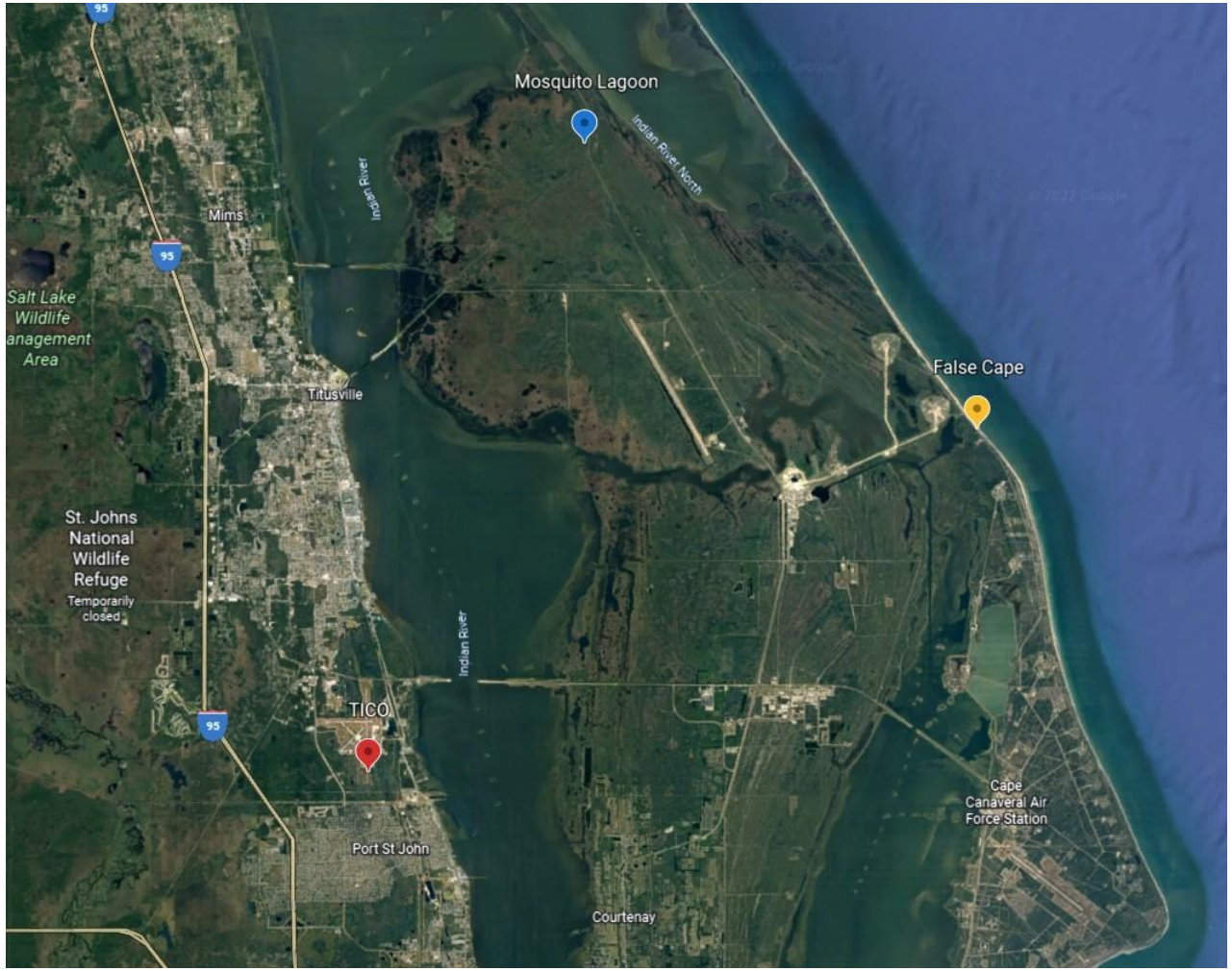
Background

- In Fall and Winter 2020-2021 the United States Space Force (USSF) requested NASA's Marshall Space Flight Center (MSFC) Natural Environments Branch (NE) to evaluate wind output from the DRWP systems
- These analyses found that data availability was low in the lowest few altitudes of a profile
- To increase available data, the USSF modified the internal quality control (QC) check
- In Fall 2021 the USSF requested NASA's MSFC NE to evaluate the modified QC algorithm by comparing the data processed by the modified method (referred to as beam data) to data processed with the original QC method (referred to as original data)
- So far, this comparison has been completed for Titusville-Cocoa (TICO), False Cape and Mosquito Lagoon 915-MHz DRWPs
- Merritt Island and South Cape will be completed once MSFC NE receives the data

Period of Record and Locations

- Period of Record (POR):
  - TICO: June 29, 2020 – January 26, 2021
  - False Cape: October 17, 2020 – January 26, 2021
  - Mosquito Lagoon: February 10, 2021 – September 30, 2021

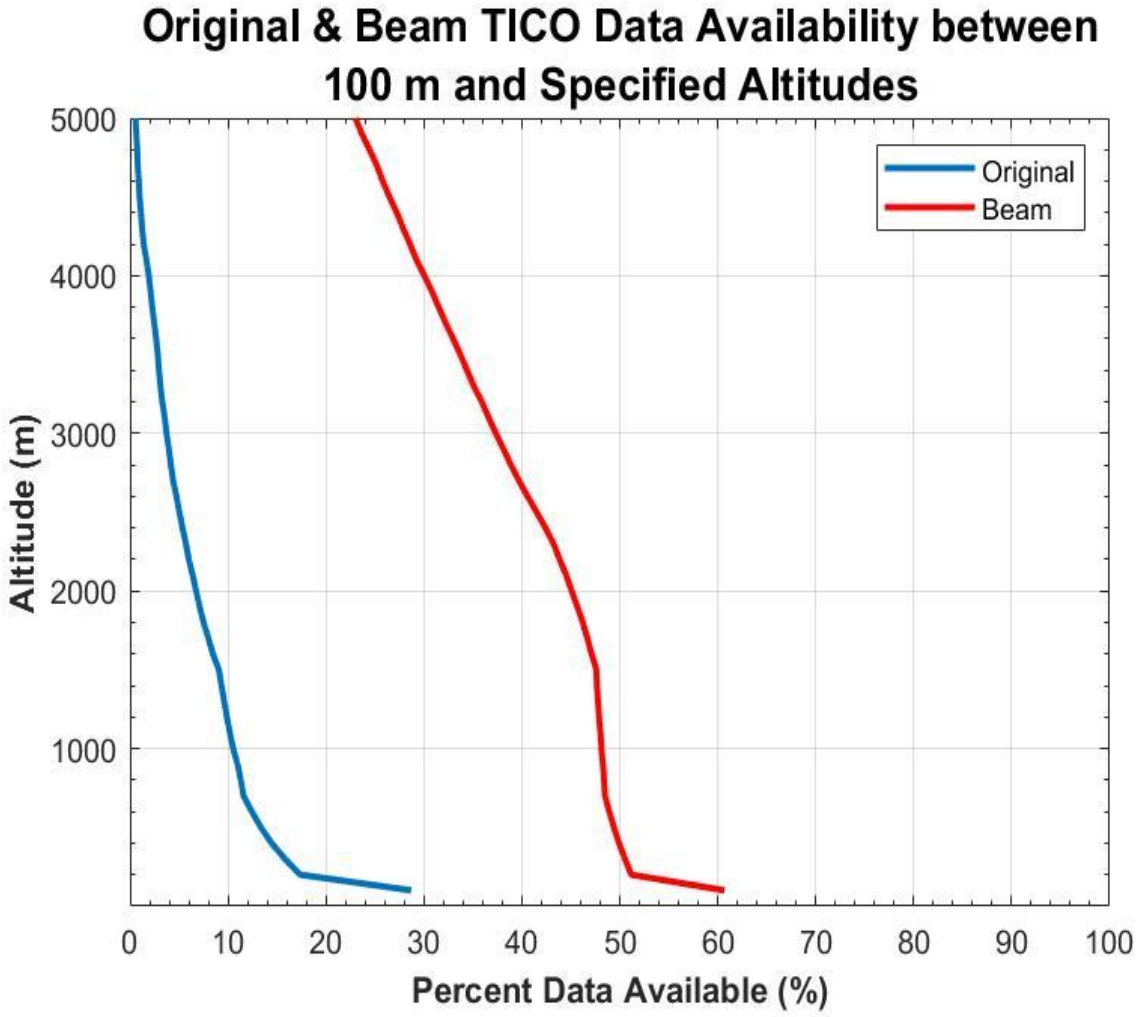


Location of the TICO DRWP (denoted by the red marker), False Cape DRWP (yellow marker) and Mosquito Lagoon (blue marker)

Analyses

- Assessed data availability versus altitude to quantify how much more data passed the checks contained in the updated QC method
- Compared DRWP wind profiles from the original QC method to concurrent DRWP wind profiles from the updated QC method to quantify the differences between output generated by each method
- Mean and root-mean-square (RMS) wind component, vector wind magnitude and wind direction deltas were calculated to statistically characterize the differences between the datasets

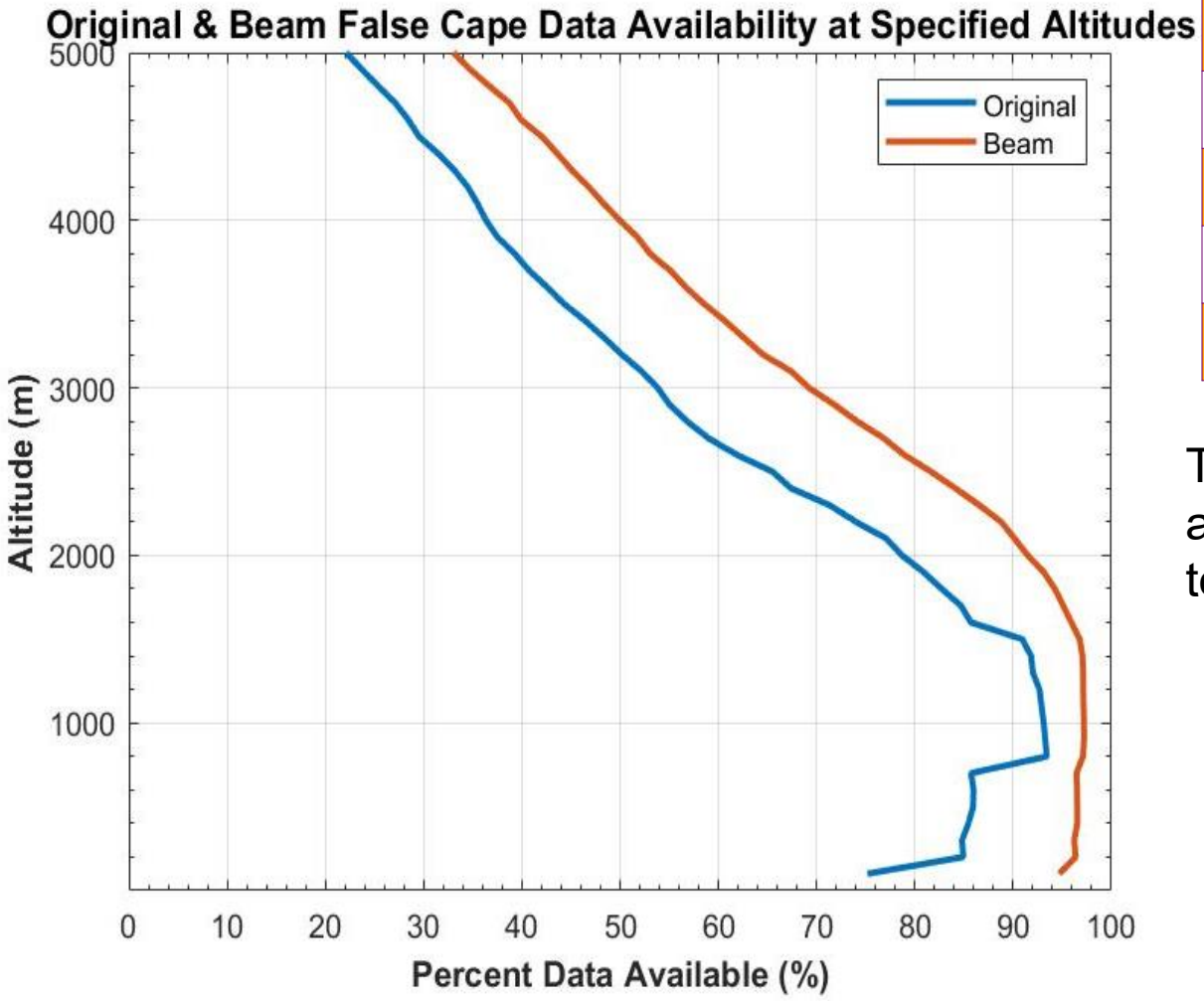
Data Availability Between 100 m and Specified Altitudes



	TICO	False Cape	Mos. Lagoon
100 m	32.0%	19.5%	20.2%
200 m	33.8%	24.9%	23.2%
2,500 m	36.5%	44.0%	29.6%
5,000 m	22.5%	16.8%	18.2%

The above table shows the percent increase in data availability from 100 m to specific altitudes from the original dataset to the updated “beam” dataset for the 3 DRWPs.

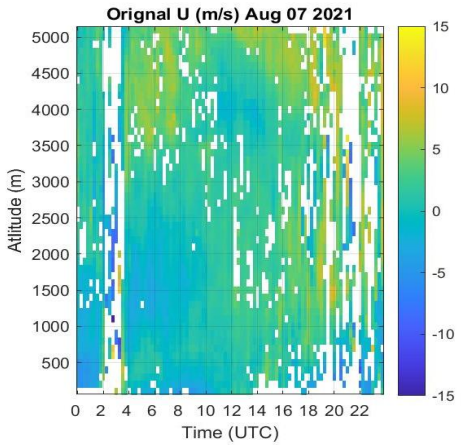
Data Availability at Specified Altitudes

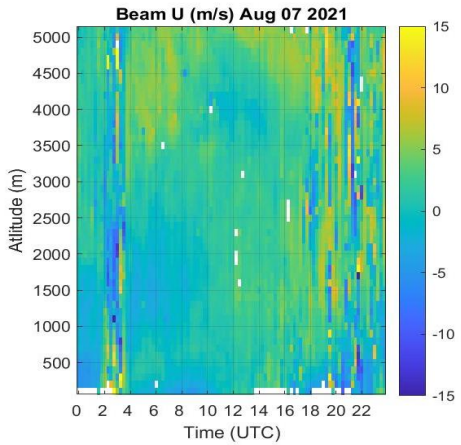


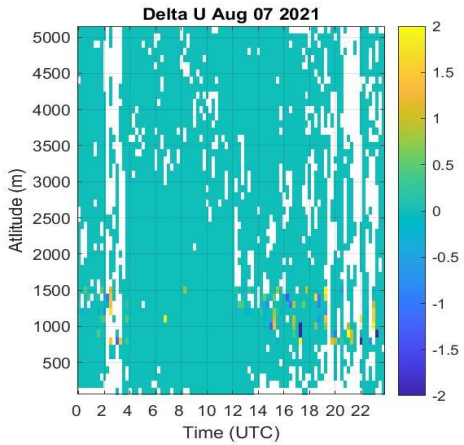
	TICO	False Cape	Mos. Lagoon
100 m	32.0%	19.5%	20.2%
200 m	35.7%	11.4%	28.7%
2,500 m	15.1%	16.1%	14.3%
5,000 m	18.9%	10.9%	14.1%

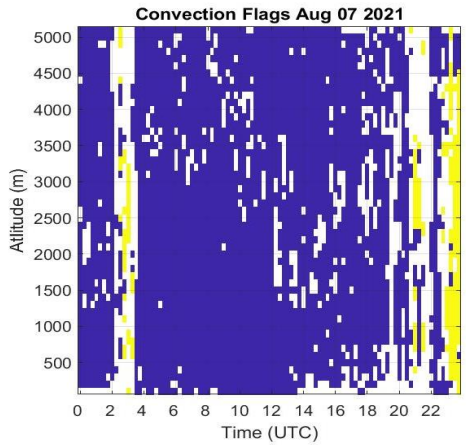
The above table shows the percent increase in data availability at specific altitudes from the original dataset to the updated “beam” dataset for the 3 DRWPs.

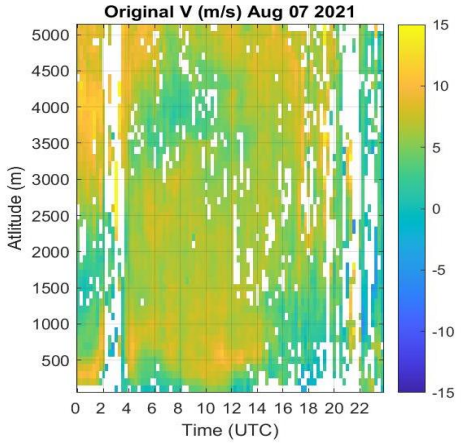
Time-Height Section Plots

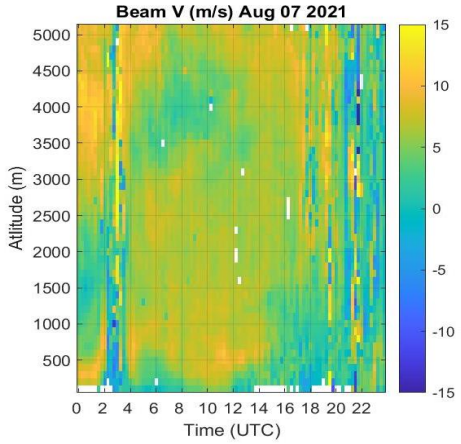


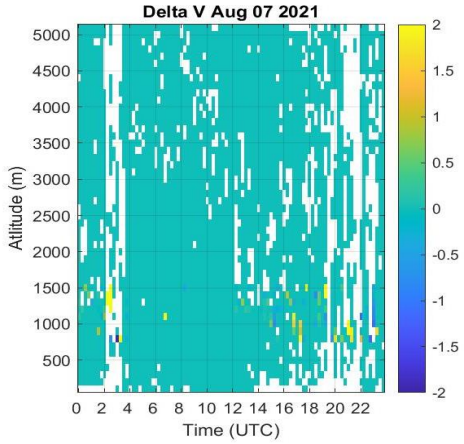


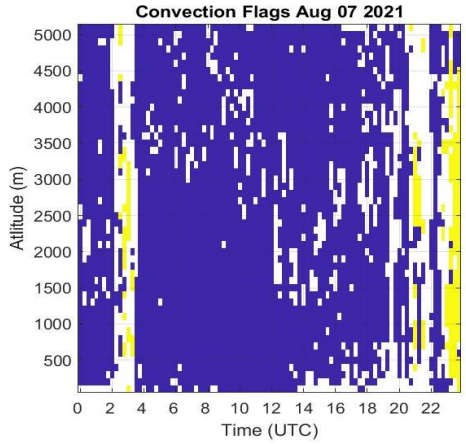










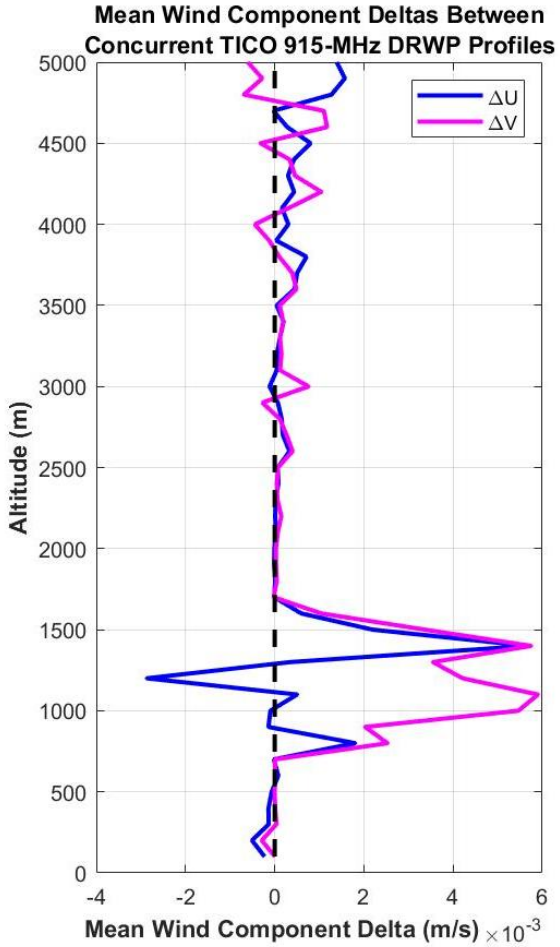


- Time-height section plots visually show more data being kept in the updated ‘beam’ dataset
- Any delta between datasets is 2 m/s or less
- The updated process does appear to be keeping data that’s affected by convection

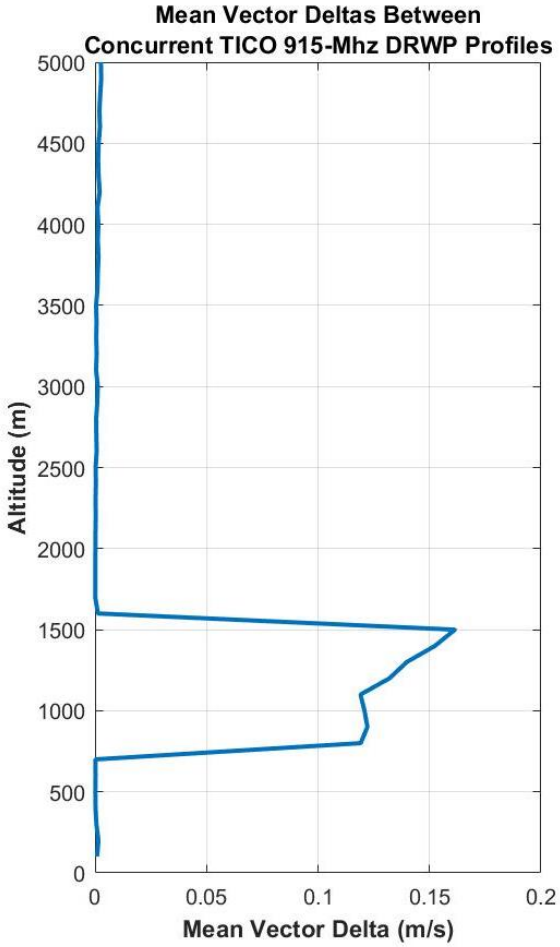
Time-Height section plots for Mosquito Lagoon on August 7, 2021.

Mean Wind Component, Vector & Wind Direction Deltas

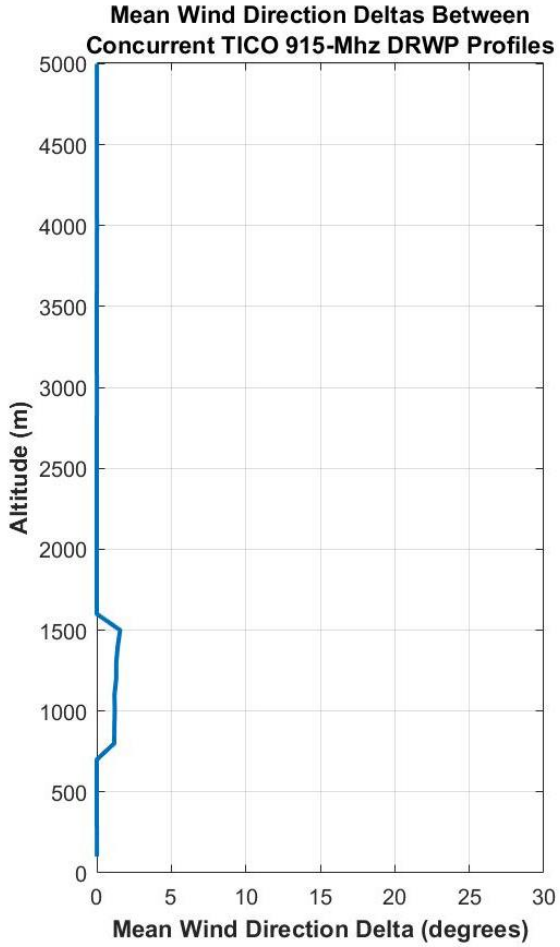
- Mean ΔU & ΔV remained close to 0 m/s for most of the profile except between 700-1,700 m where values ranged -0.003-0.006 m/s
- Mean vector deltas remained close to 0 m/s, raising to 0.1991 m/s at 800m & peaking at 0.1614 m/s at 1,500 m
- Mean wind direction deltas remained at 0° for majority of profile, peaking at 1.569° at 1,500 m
- False Cape & Mosquito Lagoons had very similar values



$$\Delta U = U_O - U_B \quad \Delta V = V_O - V_B$$



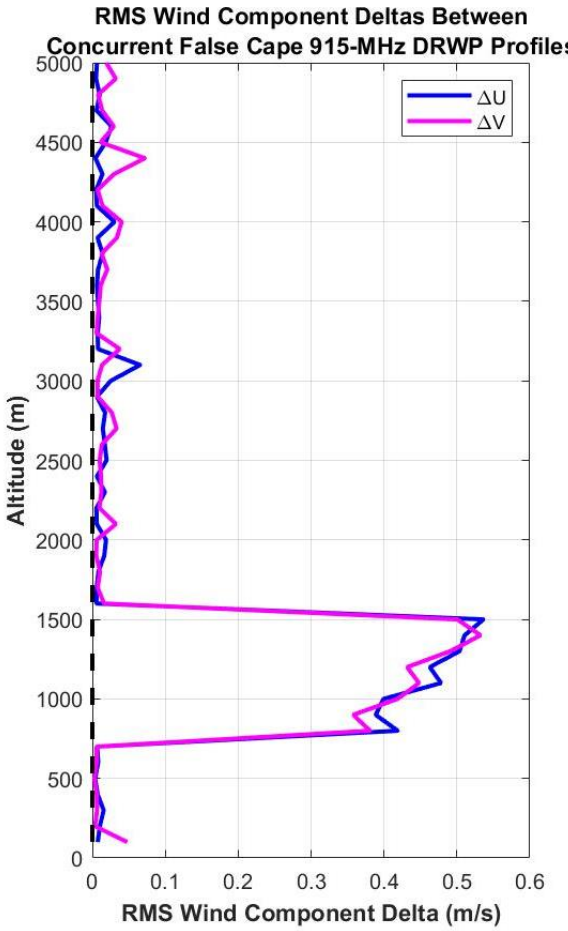
$$\Delta V = \sqrt{\Delta U^2 + \Delta V^2}$$

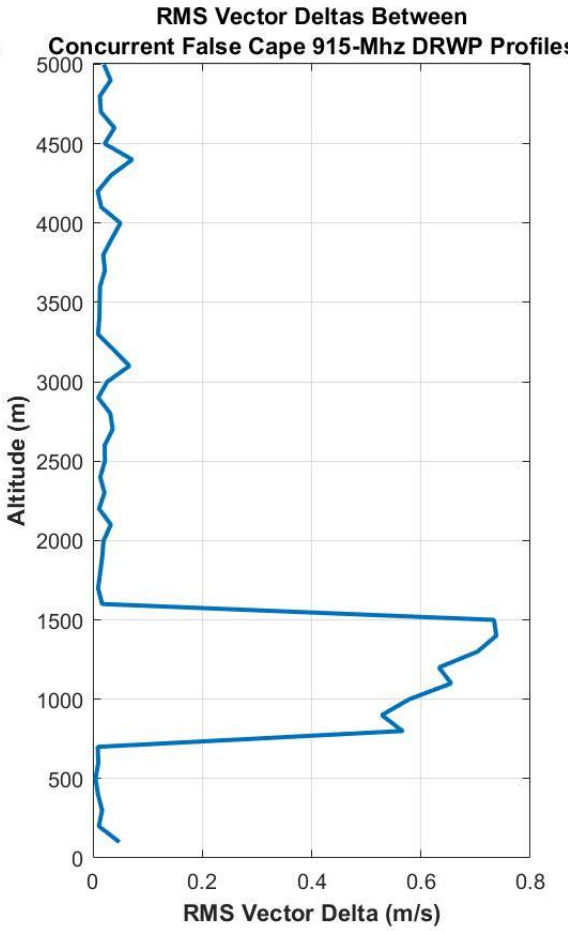


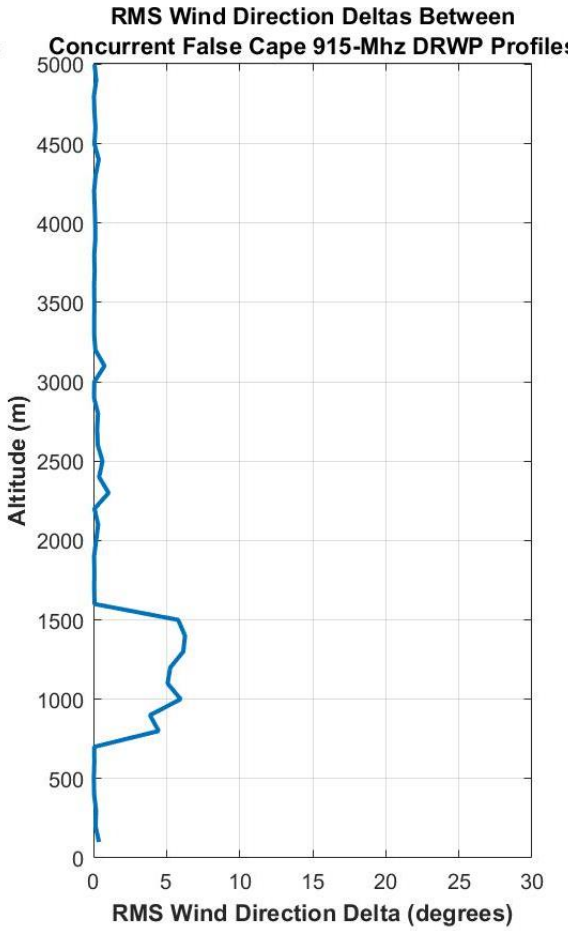
$$\Delta\theta = cos^{-1}\left(\frac{U_O * U_B + V_O * V_B}{WS_O * WS_B}\right)$$

RMS Wind Component, Vector & Wind Direction Deltas

- RMS ΔU & ΔV remained close to 0 m/s for most of the profile except between 800-1,500 m where values ranged 0.4-0.5 m/s
- RMS vector deltas remained close to 0 m/s, raising to 0.5662 m/s at 800m & peaking at 0.7336 m/s at 1,500 m
- RMS wind direction deltas remained at 0° for majority of profile, peaking at 5.793° at 1,500 m
- TICO & Mosquito Lagoons had very similar values







$$\Delta U = U_O - U_B \quad \Delta V = V_O - V_B$$

$$\Delta V = \sqrt{\Delta U^2 + \Delta V^2}$$

$$\Delta\theta = cos^{-1}\left(\frac{U_O * U_B + V_O * V_B}{WS_O * WS_B}\right)$$

Summary

- All 3 DRWP locations had an increase in data availability for the entire profile with the updated QC algorithm
- Time-height section plots visually showed the increase in data from the original dataset to the updated dataset
  - It was found that the updated QC algorithm does allow in data points affected by convection
- Mean & RMS wind component, vector and wind direction deltas were close to 0 for most of the profile, except between 800 m and 1,500 m where values still remained small
- MSFC NE plans to complete this comparison for Merritt Island and South Cape once data for those locations is received